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Incidence of *Phoma* leaf spot disease of large cardamom (*Amomum subulatum* Roxb.) and *in vitro* evaluation of fungicides against the pathogen

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Abstract

Surveys conducted in 17 locations in North East India indicated that the incidence of *Phoma* leaf spot disease of large cardamom (*Amomum subulatum*.) caused by *P. hedericola* ranged from 5% to 15%. Six fungicides were evaluated *in vitro* against the pathogen and carbendazim 50WP was significantly effective at all concentrations (0.05% - 0.15%) tested followed by carbendazim + mancozeb 75WP (0.1% - 0.4%).

Keywords: *Amomum subulatum*, fungicide, *in vitro* evaluation, large cardamom, leaf spot, *Phoma hedericola*.

Large cardamom (*Amomum subulatum* Roxb.) is the principal cash crop in the sub-Himalayan state of Sikkim and in Darjeeling hills of West Bengal. A leaf spot disease caused by *Phoma hedericola* (Dur. & Mont.) Boerema, first noticed in 2007 (Saju *et al.* 2011) has created concern to large cardamom cultivation in some endemic pockets in the region. The disease initiates as a small circular water-soaked lesion on younger leaves. The centre of the spot becomes greyish surrounded by a water-soaked margin and develops a prominent yellow halo. Gradually the spots turn yellow and brown and sometimes black. Many spots coalesce to form a large patch on the lamina resembling blighted leaf and sometimes the whole plant is infected.

Studies on distribution and *in vitro* evaluation of fungicides against the *P. hedericola* were undertaken to formulate management strategies against the pathogen.

During routine visits for advisory services, the occurrence of *Phoma* leaf spot (PLS) was recorded from 17 locations in Sikkim, Darjeeling (West Bengal) and Arunachal Pradesh. The incidence of the disease, major symptoms and parts affected were noted. For recording the incidence of PLS, 50 large cardamom clumps at a random spot in each plantation were observed and the number of infected clumps was counted. Even if one tiller in a clump was infected, the plant was considered as diseased.

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P. hedericola was isolated from the infected leaves of large cardamom collected from the Research Farm of Indian Cardamom Research Institute located at Pangthang. The isolation was done on potato dextrose agar (PDA) and the culture was maintained on slants of the same medium. The sensitivity of *P. hedericola* to six fungicides (copper oxychloride 50WP, mancozeb 75WP, carbendazim + mancozeb (12+ 63) 75WP, carbendazim 50WP, sulphur 80WP and thiophanate methyl 70WP) was evaluated by poisoned food technique (Nene & Thapliyal 1993). Each fungicide (except carbendazim) was evaluated at 0.1%, 0.2%, 0.3% and 0.4% concentrations based on active ingredient. Carbendazim was evaluated at 0.05%, 0.1% and 0.15% concentrations. Four replicates of each concentration were maintained. After 5 days of incubation at 22-23°C, the diameter of the colony was measured and inhibition of growth relative to control was calculated. The fungicide was considered to be toxic at a particular concentration when 50% or more growth of the fungus was inhibited. The per cent

inhibition values were transformed to angular values prior to statistical analysis and tested by ANOVA.

Disease incidence

The incidence of *Phoma* leaf spot was noticed at 17 locations in Sikkim, Darjeeling and Arunachal Pradesh and varied from 5% to 15% among grown up plants. In a seedling (composite) nursery in Naharlagoon (Papumpara District, Arunachal Pradesh), the disease incidence was approximately 90% (Table 1). No alternative hosts were noted during the expedition in the vicinity of the plantation.

In vitro evaluation of fungicides

All the fungicides inhibited the growth of the pathogen at all the test concentrations to varying degrees. At 0.05% concentration, only carbendazim was evaluated and there was 87.18% inhibition of the pathogen. All the fungicides were evaluated at 0.1%, and

Table 1. Incidence of *Phoma* leaf spot of large cardamom

State/District	Village	Cv./Var.	Incidence (%)	Period
Arunachal Pradesh				
Papumpara	Naharlagoon	OP seedlings (Composite)	90	Jul 2007
Sikkim				
East Sikkim	Lingtam	Ramnag	6	Aug 2008
	South Regu	Varlangey	8	Aug 2008
	Rongli	Varlangey	10	Aug 2008
	Samdong	Sawney	8	Jan 2010
	Pangthang	Sawney	12	Jan 2010
	Railgaon	Sawney	10	Aug 2010
West Sikkim	Soreng	Ramsey	10	Sep 2008
	Bermiok Berthang	Sawney	8	Sep 2008
	Bermiok Martam	Sawney	5	Sep 2008
	Budang	Sawney	6	Sep 2008
South Sikkim	Upper Tinkitam	Ramsey	8	Nov 2008
	Sangmoo	Sawney	15	Feb 2010
	Ravangla	Sawney	8	Feb 2010
	Kewzing	Sawney	12	Feb 2010
	Richenpong	Sawney	7	Feb 2010
West Bengal				
Darjeeling	Gothok	Varlangey	6	Jul 2010

Cv.=Cultivar; Var.=Variety; OP=Open pollinated

Table 2. *In vitro* inhibition of *Phoma hedericola* infecting large cardamom by fungicides

Fungicide	Colony diameter (mm), 5 DAI at conc. (% a.i.)						Per cent inhibition, 5 DAI at conc. (% a.i.)					
	0.05	0.1	0.15	0.2	0.3	0.4	0.05	0.1	0.15	0.2	0.3	0.4
Copper oxychloride	NT	35.4	NT	34.1	5.0	5.0	NT	9.23 (17.66)	NT	12.56 (20.79)	87.18 (69.04)	87.18 (69.04)
Mancozeb	NT	23.6	NT	19.3	18.4	5.0	NT	34.49 (38.94)	NT	50.51 (45.29)	52.82 (46.61)	87.18 (69.04)
Carbendazim + Mancozeb	NT	5.0	NT	0.50	0.50	5.0	NT	87.18 (69.04)	NT	87.18 (69.04)	87.18 (69.04)	87.18 (69.04)
Carbendazim	5.0	05.0	05.0	NT	NT	NT	87.18 (69.04)	87.18 (69.04)	87.18 (69.04)	NT	NT	NT
Sulphur	NT	27.6	NT	21.0	5.0	5.0	NT	29.23 (32.71)	NT	46.22 (42.82)	87.18 (69.04)	87.18 (69.04)
Thiophanate methyl	NT	32.4	NT	5.0	5.0	5.0	NT	16.98 (24.35)	NT	87.18 (69.04)	87.18 (69.04)	87.18 (69.04)
Control	39.0	39.0	39.0	39.0	39.0	39.0	NT	NT	NT	NT	NT	NT
CD (P=0.05)	-	5.19	-	6.02	6.04	6.05	-	2.31	-	1.18	0.53	0.00

DAI=Days after inoculation; NT=Not tested; Figures in parenthesis indicate angular transformations

carbendazim and carbendazim + mancozeb showed significantly high inhibition of the pathogen (87.18%). At 0.15%, carbendazim showed 87.18% inhibition of the pathogen and the other fungicides were not evaluated at this concentration. At 0.2% concentration, carbendazim + mancozeb and thiophanate methyl showed significantly high inhibition of the pathogen (87.18%). Carbendazim, carbendazim + mancozeb, sulphur and thiophanate methyl showed significantly high inhibition (87.18%) of the pathogen at 0.3% concentration. All the fungicides tested at 0.4% were on par with each other and showed 87.18% inhibition (Table 2). The inhibition in growth increased with increase in concentration of all fungicides tested. Carbendazim 50 WP was most effective at all the concentrations tested followed by carbendazim + mancozeb 75 WP.

The results indicated that in the large cardamom tract of Sikkim and Darjeeling hills, *Phoma* leaf spot is becoming important and may require crop protection strategies. Fungicides would be

useful in case the disease incidence is high and if permitted by law in various states. However, considering the organic status of Sikkim, eco-friendly and economically feasible disease management strategies have to be developed.

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